

BY THE U.S. GENERAL ACCOUNTING OFFICE

## Report To The Administrator Of Veterans Affairs

# VA Should Use Economic Order Quantity Principles In The Wholesale Supply System

Changes in wholesale supply operations at the Veterans Administration could reduce net ordering and carrying costs, inventory investment, and warehouse space. The primary vehicle for achieving these reductions is the economic order quantity principle--a mathematical method for determining the purchase quantity that will result in the lowest total cost to order and carry inventory. Additional reductions are possible by basing safety stock requirements on variations in customer demands and procurement leadtime requirements on actual experience.



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UNITED STATES GENERAL ACCOUNTING OFFICE  
WASHINGTON, D.C. 20548

HUMAN RESOURCES  
DIVISION

B-208494

The Honorable Robert P. Nimmo  
Administrator of Veterans Affairs


Dear Mr. Nimmo:

This report discusses the benefits of using economic order quantity principles in the wholesale supply system and suggests ways to improve the requirements determination process.

This report contains recommendations to you on pages 13 and 16. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget, and to the Chairmen, House Committee on Government Operations, Senate Committee on Governmental Affairs, and House and Senate Committees on Appropriations and on Veterans Affairs.

Sincerely yours,

  
Gregory J. Ahart  
Director



GENERAL ACCOUNTING OFFICE  
REPORT TO THE ADMINISTRATOR  
OF VETERANS AFFAIRS

VA SHOULD USE ECONOMIC  
ORDER QUANTITY PRINCIPLES  
IN THE WHOLESALE SUPPLY  
SYSTEM

D I G E S T

Changes in wholesale supply operations at the Veterans Administration (VA) can result in reductions in net ordering and carrying costs, inventory investment, and warehouse space.

The VA wholesale supply system consists of a marketing center and three storage depots. They support 172 medical centers and numerous other facilities. At the end of fiscal year 1981, the wholesale inventory value was \$58 million. Inventory purchases totaled \$173 million during the year.

GAO made this review to determine the benefits of using economic order quantity (EOQ) principles to compute order quantities for wholesale supply items at VA. The EOQ principle is a mathematical method for determining the purchase quantity that will result in the lowest total cost to order and carry inventory.

VA uses EOQ principles in determining reorder quantities at the medical centers but does not use these principles at the wholesale supply level. Instead, order quantities are based on a selected number of months of demand. Over the years, VA has maintained that EOQ was not a practical alternative to its existing method of computing wholesale supply requirements because of various constraints, such as seasonal pack items, shelf-life items, fund availability, warehouse space, and procurement leadtime. GAO found that these constraints can be accommodated in an EOQ system and that by using EOQ principles at the wholesale level, VA can

--save \$5 million annually in total costs to order and carry inventory,

--reduce the inventory investment by \$35 million, and

--lessen the need for warehouse space.

On some items, EOQ can be modified to take advantage of purchase and transportation discounts and other cost considerations. This can be done and still achieve savings. (See ch. 3.)

The above benefits relate to operating stocks. Additional benefits are possible by revising the policies on procurement leadtime and safety level stocks. Procurement leadtime covers the period from initiation of procurement action to receipt of the item. Safety stock covers unanticipated demand surges and interruptions in deliveries.

VA bases leadtime and safety requirements on fixed periods of time. For example, the safety stock policy is to have one additional month of stock in the inventory. Variations in customer demands for individual items are not considered. Computing more realistic safety stock levels and establishing more accurate leadtime requirements, based on actual experience for each item, could further reduce the inventory investment. (See ch. 4.)

GAO recommends that the Administrator of Veterans Affairs:

- Adopt EOQ principles in computing wholesale inventory order quantities and modify them, where necessary, to take advantage of purchase and transportation discounts.
- Reduce excess inventories compatible with EOQ principles.
- Assess the impact of EOQ on the plans to expand the storage facilities at one of the supply depots.
- Establish a process to assure that the costs to order and carry stocks are continually updated.
- Relate safety stock levels to demand variances for individual items.
- Use actual leadtime data in determining procurement leadtime stock levels for individual items.

VA generally agreed with GAO's recommendations. (See app. II.) VA stated that it would implement

appropriately modified EOQ principles at the wholesale supply level. The EOQ principles will begin on the high-dollar volume items and should result in improved buying habits and more reasonable inventory levels.

VA did question some of the details in the report presentation. VA's comments have been considered in finalizing the report.





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## ABBREVIATIONS

|     |                           |
|-----|---------------------------|
| EOQ | economic order quantity   |
| GAO | General Accounting Office |
| VA  | Veterans Administration   |



## CHAPTER 1

### INTRODUCTION

The basic challenge of inventory management is having the proper amount of stock on hand when required--neither too much nor too little. If inventory levels are too low, the supply system cannot satisfy all customer demands and must undertake costly and often wasteful efforts to recover from out-of-stock positions. If inventory levels are too high, money is invested on inventories which may never be used. In addition, a whole train of unnecessary expenditures is set in motion for more warehouses, transportation, and personnel; storage and distribution facilities are overcrowded; maintenance in storage workload is increased; and inventory excesses are generated which must eventually be purged from the system. Therefore, successful inventory management requires that basic principles of inventory control be understood and executed.

### THE EOQ PRINCIPLE--A BASIC SUPPLY MANAGEMENT TECHNIQUE

The Federal Property Management Regulations require that all executive agencies, except the Department of Defense, use the economic order quantity (EOQ) principle to determine inventory replenishment quantities. The EOQ principle is a mathematically proven method to minimize the total cost to order and carry inventory. Although agencies have adopted different formulas or models to establish EOQ, the objective is essentially the same--to order that quantity which will balance the cost of carrying inventory with the cost of repetitive procurements.

Another aspect which must be considered in conjunction with EOQ is when to buy. Agencies have generally adopted the reorder point concept in which orders are placed when inventory levels fall below some predetermined amount. This is usually the amount of stock needed to meet demands that are estimated to occur during procurement leadtime--the time from when an order is placed until it is received and recorded as available for issue--plus an additional amount of stock (safety stock) to cover unanticipated demand surges and interruptions in deliveries.

### VETERANS ADMINISTRATION SUPPLY MANAGEMENT

The Veterans Administration's (VA's) Office of Procurement and Supply provides supply support to medical programs in the Federal Government. The wholesale supply system consists of a marketing center and three storage depots. They support 172 VA medical centers, 300 additional VA facilities, and 700 other Government installations.

The VA Marketing Center in Hines, Illinois, centrally purchases and manages some 1,700 stock items which are stored at the three depots. Inventory purchases totaled \$173 million during fiscal year 1981. At the end of that fiscal year, the wholesale inventory value was \$58 million. The inventories are financed through a self-sustaining revolving fund.

The Marketing Center purchases replenishment stock on the basis of a selected number of months of demand. It does not use EOQ principles. In a prior report (B-133396, June 27, 1974), we concluded that savings could result if EOQ principles were used and recommended that the Administrator of Veterans Affairs work with the Marketing Center to implement a system using these principles. However, VA did not adopt our recommendation. In contrast, the VA medical centers use EOQ principles in computing their reorder quantities.

#### OBJECTIVES, SCOPE, AND METHODOLOGY

Our objectives were to

- determine why the Marketing Center has not used EOQ principles to compute order quantities for depot-managed items,
- determine the benefits that can result from applying EOQ principles, and
- assess the procedures for determining leadtime and safety stock levels to identify added opportunities for savings.

We reviewed pertinent VA regulations, policies, and procedures and examined the Marketing Center's method of computing replenishment quantities of depot stocks. For the three VA depots, we analyzed demand, leadtime, and safety level data and incremental procurement and possession cost data.

Our evaluation was performed at the VA Office of Procurement and Supply, Washington, D.C.; VA Marketing Center, Hines, Illinois; and VA supply depot, Hines, Illinois. We discussed the possible impact of various changes in buying practices with VA officials at these three locations and with selected VA suppliers nationwide. Also, we discussed the Federal Property Management Regulations, EOQ principles, and inventory management concepts with General Services Administration officials in Washington, D.C., and Chicago, Illinois.

Sampling techniques were used to select individual stock items for review. The Marketing Center managed 1,762 items at July 31, 1981, but we eliminated 434 items from the sample universe

primarily because they represented new items without adequate demand data, old items being dropped from the supply system, or seasonal pack items. From the remaining 1,328 items, we selected 201 items for review.

Our selection was based on a stratification of the sample universe into categories by division. The first strata was established for a group of high-value items in each division that accounted for at least 50 percent of its annual depot sales. Then, 30 items were randomly selected from the remainder of each division's items. Appendix I summarizes the sample selection by division and strata. The method used in our sample selection was discussed with VA Headquarters and Marketing Center officials.

For the sample items, we computed the order quantities and total costs to order and carry these stocks under an EOQ model and compared them with the quantities and costs under VA's existing policy. Annual savings also were computed for the individual items. Using a 95-percent confidence level, we projected these savings to the sample universe of VA depot-stocked items. Similarly, we computed the one-time reduction in inventory investment possible by using EOQ principles. For some items, we also compared safety stock levels computed on the basis of variations in demand with those computed under VA's existing policy.

Our review was performed in accordance with GAO's current "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions."

## CHAPTER 2

### EOQ PRINCIPLES USED AT RETAIL LEVEL

#### BUT NOT AT WHOLESALE LEVEL

For many years, VA medical centers have used EOQ principles in their reorder quantity computations. Conversely, the Marketing Center does not use EOQ principles to determine reorder quantities for the wholesale inventory. In the past, VA questioned the need to use these principles at the wholesale level and claimed an exemption from the Federal requirement to do so. However, VA's claim was incorrect and VA now acknowledges that it does not have an exemption.

#### MEDICAL CENTERS USE EOQ PRINCIPLES

Each medical center's supply service is required to manage and maintain appropriate stock levels in its warehouses. Centers' inventories totaled \$45 million at the end of fiscal year 1981. The medical centers order supplies from VA depots and other sources for use by individual departments, such as dietetics, radiology, pharmacy, and nursing. Reorder quantities are computed on the basis of EOQ principles and have been computer generated since 1974.

VA has reported savings since EOQ principles were incorporated into the computer formula to automatically establish medical center reorder quantities. In 1977, VA stated that the benefits included more even workload, more economical stock replenishment, and lower processing costs.

#### EOQ NOT USED AT WHOLESALE LEVEL

In response to our 1974 report recommendation that the Marketing Center implement a system using EOQ principles, VA questioned whether EOQ was a valid principle for management of inventories at the wholesale centralized distribution level. VA stated that the stock replenishment operation must accommodate such factors as seasonal pack items, shelf-life items, fund availability, warehouse space, procurement leadtime, and indefinite requirements generated by other Government agencies.

We pointed out that none of these factors were peculiar to VA and all could be accommodated in an EOQ system. We recognized, however, that all items managed by the Marketing Center may not be susceptible to strict EOQ principles due to price breaks, transportation costs, shelf-lives, seasonal purchases, and other limitations. We stated that, as provided in the Federal Property

Management Regulations, modified EOQs should be developed to take into account these limitations in order to minimize net ordering and holding costs.

Nevertheless, in March 1975 VA requested an exemption from the provisions of the Federal Property Management Regulations. VA interpreted the May 1975 response from the General Services Administration as an exemption or waiver from the requirement to use EOQ. However, in reviewing the response and discussing the matter with General Services Administration officials, it became clear to us that a waiver was not intended. Their position that executive agencies will use the EOQ concept has remained unchanged.

The General Services Administration stated that a modified EOQ--called the economic purchase quantity--can always be calculated and used since it represents the most economical quantity that can be purchased given all known factors, such as price discounts, transportation economies, cost of capital, and cost to procure. The General Services Administration emphasized that the economic purchase quantity is a modification based on the EOQ calculation which must be present for comparison purposes.

During the current review, VA officials stated that they misunderstood the General Services Administration's letter and acknowledged that they do not have a waiver from using EOQ principles in their wholesale operation.

### CHAPTER 3

#### THE MARKETING CENTER

##### SHOULD USE EOQ PRINCIPLES

The use of EOQ principles can result in reductions in net ordering and carrying costs, inventory investment, and warehouse space. By using these principles, we estimate that the Marketing Center can

- save over \$5 million annually in total costs to order and carry inventory,
- reduce its inventory by almost \$35 million, and
- lessen its need for warehouse space.

On some items, EOQ can be modified to take advantage of quantity and transportation discounts and other cost considerations. This can be done and still achieve savings. Irrespective of whether the basic or modified EOQ method is used, costs to order and carry stocks must be continually updated to effectively use EOQ principles.

##### SAVINGS IN TOTAL COSTS TO BUY AND CARRY INVENTORY

The Marketing Center purchases stock for replenishment on the basis of a selected number of months of demand. Replenishments are triggered by stock levels established for each item and are based on past usage criteria. If the Marketing Center was to use EOQ principles, which determine order quantities that minimize the total costs to buy and carry inventory, we estimate that it could potentially reduce total costs by over \$5 million annually.

For the 201 sample items, we determined the actual cost incurred by the Marketing Center during fiscal year 1991 to order and carry these items and computed what the costs would have been had the Center used EOQ principles. We found that the Center could have saved over \$1.4 million. As shown in the table on the following page, savings by division varied from \$3,600 for a single high value item in one division to over \$500,000 for 30 high-value items in another division.



| Division                              | Sample items |            |            | Annual savings     |                  |                    |
|---------------------------------------|--------------|------------|------------|--------------------|------------------|--------------------|
|                                       | High value   | Random     | Total      | High value         | Random           | Total              |
| Medical and scientific supplies       | 38           | 30         | 68         | \$ 461,100         | \$ 61,500        | \$ 522,600         |
| Administrative supplies and equipment | 1            | 30         | 31         | 3,600              | 17,900           | 21,500             |
| Subsistence                           | 12           | 30         | 42         | 128,700            | 87,700           | 216,400            |
| Drugs and chemicals                   | <u>30</u>    | <u>30</u>  | <u>60</u>  | <u>556,400</u>     | <u>109,900</u>   | <u>666,300</u>     |
| Total                                 | <u>81</u>    | <u>120</u> | <u>201</u> | <u>\$1,149,800</u> | <u>\$277,000</u> | <u>\$1,426,800</u> |

Savings occurred on all but nine items. For example, savings were over \$52,700 for electric beds, \$48,800 for manual beds, \$26,600 for mattresses, \$18,600 for wheelchairs, and \$18,000 for surgical sponges. Savings were not realized on nine items because the stock position maintained was at a level lower than the established policy.

Two items illustrate how the savings could be achieved. On liquid vanilla--purchased under a term contract--the Marketing Center could have saved nearly \$11,400 in fiscal year 1981 if it had used EOQ principles. Depending upon the depot, the Marketing Center issued from 11 to 31 delivery orders against this contract and maintained an average monthly operating level inventory of about 295,000 units valued at over \$94,000 for all three depots. If EOQ principles had been used, the Marketing Center would have requested more frequent deliveries (27 to 49 a depot) at the same unit price under the term contract and would have maintained an average operating level inventory of 42,500 units valued at about \$13,600. As a result, ordering costs would have increased, but carrying costs would have decreased to a much larger extent. A comparison of the annual costs under both methods is set out below.

|               | Marketing Center | EOQ            | Savings         |
|---------------|------------------|----------------|-----------------|
| Cost to carry | \$14,500         | \$2,100        | \$12,400        |
| Cost to order | <u>1,100</u>     | <u>2,100</u>   | - <u>1,000</u>  |
| Total         | <u>\$15,600</u>  | <u>\$4,200</u> | <u>\$11,400</u> |

On another item, a competitively purchased injectable antibiotic, the Marketing Center could have saved over \$53,000 in fiscal year 1981 if it had used EOQ principles. The Marketing Center purchased this item about every 4 months during the year and maintained an average monthly operating level inventory of about 158,000 units valued at over \$375,000. If EOQ principles had been used, the Marketing Center would have purchased items more frequently or arranged for more frequent deliveries (29 to 46 times a depot a year) and maintained an average operating level inventory of almost 6,700 units valued at about \$16,000. A summary of annual savings based on the cost to order and carry inventories of this item under both methods is set out below.

|               | <u>Marketing<br/>Center</u> | <u>EOQ</u>     | <u>Savings</u>  |
|---------------|-----------------------------|----------------|-----------------|
| Cost to carry | \$57,500                    | \$2,500        | \$55,000        |
| Cost to order | <u>500</u>                  | <u>2,500</u>   | <u>- 2,000</u>  |
| Total         | <u>\$58,000</u>             | <u>\$5,000</u> | <u>\$53,000</u> |

By projecting the sample results to the universe of 1,328 supply items, we estimate that the Marketing Center can reduce total costs to procure and hold inventory by over \$5 million annually. The range of estimates and statistical projection of savings by division, at a 95-percent confidence level, is shown in the following table.

| <u>Division</u>                       | <u>Range</u> |             | <u>Projection</u>  |
|---------------------------------------|--------------|-------------|--------------------|
|                                       | <u>Low</u>   | <u>High</u> |                    |
| Medical and scientific supplies       | \$1,055,582  | \$1,593,383 | \$1,324,482        |
| Administrative supplies and equipment | 23,430       | 66,318      | 44,874             |
| Subsistence                           | 355,707      | 626,458     | 491,083            |
| Drugs and chemicals                   | 1,594,544    | 4,690,462   | <u>3,142,503</u>   |
| Total                                 |              |             | <u>\$5,002,942</u> |

## REDUCTIONS IN INVENTORY INVESTMENT

A major benefit of applying EOQ principles at the Marketing Center is the reduced investment needed in inventory stock. Our review showed that the Marketing Center could reduce its wholesale inventory investment by an estimated \$35 million.

When holding costs increase at a greater rate than procurement costs, it is advantageous to buy smaller quantities more frequently. With today's high interest rates, it is costly and inefficient to maintain inventories at levels higher than necessary.

In the previous section, we showed that, by using EOQ principles, the operating level inventory investment in liquid vanilla could have been reduced from \$94,000 to \$13,600 and the investment in an antibiotic could have been reduced from \$375,000 to \$16,000. A similar comparison for 10 high-value drug and chemical items (e.g. inderal, motrin, cleocin) also showed large reductions. By using EOQ techniques on these 10 items, the 1981 operating level inventory investment would be reduced by \$1.8 million.

For the entire sample of 201 items, the operating level inventory investment would be reduced from \$11.2 million to \$1.3 million, or a difference of \$9.9 million. By projecting the sample results to the universe of 1,328 items stocked at the three depots, we estimate that the Marketing Center can reduce its inventory investment by almost \$35 million if EOQ principles were used. This is a sizable reduction in relation to the total wholesale inventory value of \$58 million. The range of estimates and statistical projection of reductions by division, at a 95-percent confidence level, is shown in the following table.

| <u>Division</u>                       | <u>Range</u> |              | <u>Projection</u>   |
|---------------------------------------|--------------|--------------|---------------------|
|                                       | <u>Low</u>   | <u>High</u>  |                     |
| Medical and scientific supplies       | \$ 7,759,000 | \$11,633,000 | \$ 9,696,000        |
| Administrative supplies and equipment | 191,000      | 486,000      | 339,000             |
| Subsistence                           | 2,156,000    | 3,852,000    | 3,004,000           |
| Drugs and chemicals                   | 11,499,000   | 30,736,000   | <u>21,850,000</u>   |
| Total                                 |              |              | <u>\$34,889,000</u> |

## LESS NEED FOR WAREHOUSE STORAGE SPACE

The substantial one-time reduction in inventory investment discussed in the prior section should result in a corresponding reduction in warehouse storage space. Since more orders will be generated as a result of smaller quantity purchases when EOQ principles are applied, more activity will occur at the receiving sections of each depot. On the other hand, reductions in the amount of storage space required should also take place.

Electrical beds illustrate the lessened requirement for warehouse storage space. By using EOQ principles, the operating level inventory investment would be reduced from \$323,000 to \$11,000 for electrical beds at the three depots. During fiscal year 1981, the Marketing Center maintained an average operating level inventory of 282 electric beds at the Hines depot. This quantity represented a 313-day supply. Similarly, the Somerville depot had an average inventory of 242 electrical beds, or a 357-day supply, and the Bell depot had an average inventory of 53 beds, or a 94-day supply. Under the EOQ concept, the average number of days of operating level stock would be 9 at Hines, 10 at Somerville, and 11 at Bell.

These large inventory reductions would free considerable storage space. Although all items stocked at the depots are not as bulky as beds or mattresses, sizable space reductions should occur since 200 of the 201 sample items would have large reductions in onhand stocks under the EOQ concept.

In a prior report on VA's planned expansion of the Hines supply depot (B-197773, Feb. 26, 1980), we pointed out that the need for more storage space had not been justified and was questionable. Nevertheless, VA awarded a contract to develop work plans for the Hines depot expansion. Construction is scheduled to begin in January 1983 and will add 78,500 square feet of receiving and storage space to the depot. The project also will correct safety deficiencies, improve electric and heat systems, and provide handicap facilities. This project is estimated to cost \$9 million.

During our review and discussions, we found no indication that the reduced storage space needs, resulting from the use of EOQ principles, had been considered by VA in planning for the depot expansion.

## EOQ CAN BE MODIFIED AND STILL ACHIEVE SAVINGS

EOQ can be modified to take advantage of quantity and transportation discounts and other cost considerations. While

the EOQ principle achieves the minimum total cost for ordering and holding stock, it assumes a fixed unit price for an item. Sometimes, however, discounts are offered or transportation costs are reduced as a result of quantity purchases. When this occurs, a broader evaluation of EOQ must be made. This evaluation is known as the economic purchase quantity. The practice of modifying the EOQ computation is accepted because it is an extension of the concept and achieves the lowest total cost considering an additional cost element--the unit purchase cost of the item itself.

Over the years VA has maintained that EOQ was not a practical alternative to its existing method of computing wholesale supply requirements because of various constraints, such as family groupings, seasonal pack items, and shelf-life items. The General Services Administration, on the other hand, maintains that an economic purchase quantity can always be calculated since it represents the most economical quantity the procurement activity can purchase, given all known facts, and is a modification or extension of the EOQ calculation. We agree and believe that the constraints identified by VA are procurement conditions that exist and should be considered in arriving at the most economical purchase quantity and are not reasons for avoiding the use of EOQ principles.

VA officials believe that vendors will charge higher prices because smaller quantity purchases are considered a general effect of applying EOQ principles. Although ordering smaller quantities generally results in higher prices, this is not always the case. One vendor stated that because of the large quantities purchased by VA, he was actually required to schedule large production runs at premium prices, thereby causing higher unit costs. Thus, smaller orders would be less costly to this vendor and perhaps allow him to lower his prices to VA. The smaller quantities would also reduce VA's storage costs and costs to carry and finance the inventory. Another vendor expressed the same idea, saying he buys his stock in small quantities and turns his inventory over 17 times a year because it is more profitable.

Other vendors provide stock to VA under term contracts, whereby unit prices are fixed for a period of time and quantities can be ordered as needed. Smaller quantities could, therefore, be ordered at no increase in price. Likewise, on fixed price contracts, the Marketing Center could procure the same fixed quantities but provide for more frequent, smaller deliveries.

In many cases the Marketing Center could order quantities somewhat higher than EOQ--but much lower than the current system--and still realize most of the savings possible by using EOQ principles. For example, the Marketing Center's current practice is to order cranberry juice in railcar lots--two at a time--although the vendor actually delivers the order by truck. This

vendor told us that in his operation and price structure, there were no transportation savings for larger than truckload orders. When using our basic EOQ model, we noted that over \$7,000 could be saved annually. However, even if the order quantity was adjusted to a full truckload, we found that \$6,000 could still be saved annually by using the modified EOQ instead of the current method.

ORDERING AND CARRYING COSTS  
MUST BE CONTINUALLY UPDATED

To effectively apply EOQ principles, costs to order and carry stock need to be continually updated. Optimum order quantities cannot be established or the total lowest cost determined without using current costs. Again, the goal of the EOQ theory is to order the quantity which balances the two basic costs--ordering and carrying--to obtain the lowest total cost. The ordering cost is expressed as a cost per line item and the carrying cost as a percentage of average inventory value.

Since the Marketing Center did not use EOQ principles, it could not determine that the quantities ordered were the most economical quantities to buy. At our request, VA developed the ordering and carrying costs for the EOQ model we used. Marginal or incremental ordering cost--the cost per order for each additional order based on a 50-percent change in the order level--was developed for each division.

| <u>Division</u>                          | <u>Marginal<br/>ordering costs</u> |
|--|------------------------------------|
| Medical and scientific supplies          | \$28.21                            |
| Administrative supplies and<br>equipment | 20.35                              |
| Subsistence                              | 17.02                              |
| Drugs and chemicals                      | 20.90                              |

Carrying or holding cost, as developed, totaled 18 percent for the Bell depot and 15 percent for both the Hines and Somerville depots.

Although the ordering and holding costs were the best estimates at the time, they must be continually updated to effectively manage and minimize the cost of inventory and to establish the most economical quantity to buy.

## CONCLUSIONS AND RECOMMENDATIONS

We believe that, by using EOQ principles, the Marketing Center can save over \$5 million annually in total costs to order and carry inventory, reduce its inventory by almost \$35 million, and lessen its need for warehouse space. Savings can be realized by modifying the basic EOQ principles to take advantage of quantity and transportation discounts. To achieve optimal benefits, VA must continuously update its costs to order and carry stock.

We recommend that the Administrator of Veterans Affairs direct the Assistant Deputy Administrator for Procurement and Supply to:

- Adopt EOQ principles in computing wholesale inventory order quantities at the Marketing Center. Modify the principles, where necessary, to take advantage of quantity and transportation discounts.
- Reduce existing excess inventories compatible with EOQ principles.
- Assess the impact of EOQ on the need to expand the storage facilities at the Hines supply depot.
- Establish a continuing process to assure that the costs to order and carry stocks are reasonable and current and provide the ability to determine that the lowest total overall costs are being incurred when replenishing depot stocks.

## AGENCY COMMENTS AND OUR EVALUATION

VA stated that it will implement appropriately modified EOQ principles at the wholesale level after considering such factors as volume discounts, transportation cost effects, and currently available personnel and other resources. (See app. II.) These modified EOQ principles will begin on the high-dollar volume items in the inventory and should result in improved buying practices and more reasonable inventory levels. VA also stated that it would continue its efforts to assure that costs to order and carry stocks are reasonable and current.

VA agreed that using EOQ principles should result in inventory reductions. However, with regard to our recommendation on the Hines depot expansion project, VA stated that the project would not be materially affected by using EOQ because it includes only about a 10-percent increase in actual storage space. Other than the electric beds, VA did not foresee any significant amount of storage space becoming available as a result of applying EOQ principles.

We disagree since it stands to reason that the substantial reduction in inventories--over 90 percent on some items--discussed in our report should result in a corresponding reduction in the need for warehouse storage space. Furthermore, we observed that, while the space occupancy rate was high on a square foot basis, a considerable amount of empty space was available because inventories were not stored in a manner which made best use of floor to ceiling cubic space.

Although generally agreeing with our recommendations, VA questioned some of the details in our report. VA stated that the marginal ordering cost of \$28.21 for one division appeared to be incorrect because most of the items in the division required a technical acceptance inspection, costing a minimum of \$15 in addition to the normal receiving cost. VA provided us the \$28.21 cost figure which we used in our calculations. The \$15 cost figure relates to a new inspection procedure which has not yet been fully implemented.

The estimated cost of the procedure is still preliminary and, in addition, it is not clear whether the cost will be fixed rather than marginal and, therefore, inappropriate for use in the EOQ calculations. Even if we accept the \$15 cost figure as valid, its effect on the estimated savings would be small. We recomputed the projected savings and found that the total estimated savings of \$5,002,942 would only be reduced by \$76,841, or 1-1/2 percent, if the marginal ordering cost for the one division was increased by the \$15 inspection cost.

VA stated that the use of EOQ principles would increase the number of orders which, in turn, would require more receiving and other personnel and more receiving dock space. Our report fully recognizes that ordering costs for most items would increase, but the increase would be far surpassed by the reduction in the costs to hold currently inflated inventories.

VA questioned one of our examples of inventory reductions, stating that the suggested average operating level inventory of 42,500 units for liquid vanilla is not realistic because it represents only a 2.8-day supply. We believe that the inventory level is realistic under the EOQ method. If EOQ quantities of liquid vanilla were delivered every 14 days to the Bell depot and every 7 days to the Hines and Somerville depots, the operating inventory would average 8,000 units, or a 7-day supply, at the Bell depot and 17,300 units, or a 4-day supply, at the Hines and Somerville depots. Further, each depot maintains a safety stock level--set at 60 days of supply for this item--which is in addition to the operating stock. Safety stocks averaged 72,000 units at the Bell depot, 281,000 units at the Hines depot, and 280,000 units at the Somerville depot.



## CHAPTER 4

### SAFETY AND LEADTIME POLICIES

#### NEED REVISION

The Marketing Center does not consider variations in customer demands or leadtimes in determining requirements for safety and procurement leadtime stocks. Computing more realistic safety stock levels and establishing more accurate leadtimes for each item could further reduce the inventory investment.

#### SAFETY STOCK LEVELS ARE UNREALISTIC

Some safety stock levels computed by the Marketing Center were unrealistically high, while others were too low to assure adequate customer service. In a supply system, stock is purchased when it is drawn down to the reorder point. At the reorder point, adequate stock remains to satisfy normal customer demands during the period from initiation of procurement action to receipt of material--the procurement leadtime. Safety level stock also remains to protect against unusually high demands during the procurement leadtime period. One procedure often used in EOQ systems is to calculate safety stock levels on the basis of variability of demand for individual items. The statistical probability theory is used to minimize the number of out-of-stock situations for the inventory as a whole.

The Marketing Center purchases stock for replenishment on the basis of the number of months of demand for individual items. The Center's safety stock policy is to maintain 1 additional month of stock in the inventory, based on the average demand for the last 6 months. This fixed time policy does not consider the maximum variations in customer demands and results in carrying more or less safety stock for individual items than necessary.

Maintaining excessive safety stock is illustrated by the case of alcohol pads, a high usage, fairly constant demand item. During the 2-year period ended June 30, 1981, the monthly customer demand at the Hines depot for alcohol pads ranged from 20,500 to 31,000 units. The Marketing Center's policy of maintaining 1 month's safety stock sets the safety stock level at 25,300 units. However, the monthly customer demand during this period would have required VA to use a maximum of 5,700 units of the safety stock. By having the safety stock level to be approximately 20,000 units higher than necessary, the Marketing Center tied up \$13,500 in overstocked inventory and incurred extra annual holding costs of over \$2,000.

For the 10 high-value drug and chemical items, we compared safety stock levels computed under the Marketing Center's policy with those calculated on the basis of variations in demand over a 24-month period. We found that safety stock levels for some items were overstated by \$547,000, while the safety stock levels for the remaining items were understated by \$71,700. Our calculations were based on a 98-percent fill rate objective; if the fill rate objective was lowered to a more reasonable percentage, the overstatements would be much larger and the understatements much smaller.

#### PROCUREMENT LEADTIMES ARE INACCURATE

The Marketing Center needs to establish more accurate procurement leadtimes for each individual item. Procurement leadtime includes two identifiable segments. The first is administrative leadtime, which covers the time from initiation of procurement action to contract award or execution of a purchase order. The second is production leadtime, which covers the period from a vendor's receipt of the contract award or purchase order to the delivery of the item.

The Marketing Center has not determined individual procurement leadtimes for each item. The Center's policy is to establish administrative leadtime by type of procurement. For example, administrative leadtime is generally 90 days for competitive procurements and 15 days for purchase orders placed against term contracts. With regard to production leadtime, the Marketing Center's longstanding practice is to allow a production leadtime of 60 to 90 days, regardless of the vendor's need or ability to deliver sooner.

The leadtimes may be too long. Vendors we talked to said they could deliver their orders in much shorter periods of time. Some vendors said they could deliver orders within 10 days. After our review was initiated, the medical and scientific supplies division surveyed its vendors and learned that many vendors only needed 45 days instead of the usual 60 to 90 days allowed.

#### CONCLUSIONS AND RECOMMENDATIONS

The Marketing Center does not use variations in demand or leadtime to set safety and procurement leadtime stock levels. Rather, it uses fixed periods. To improve supply management and to further reduce the inventory investment, we believe that the safety and leadtime stock levels should be tied to the characteristics of individual items. In this way, such factors as demand and leadtime variance and item essentiality can be considered.

We recommend that the Administrator of Veterans Affairs direct the Assistant Deputy Administrator for Procurement and Supply to establish inventory management policies which:

- Relate safety stock levels to demand variances for individual items.
- Use actual leadtime data in determining procurement leadtime stock levels for individual items. In developing the data, vendors should be consulted.

AGENCY COMMENTS AND  
OUR EVALUATION

VA stated that inventory control at the Marketing Center has been improved by consolidating inventory management of various commodity groups into one division. Operating policies for that division are being developed that will require that safety stock levels be related to demand and that leadtime variances be related to individual items.

VA cautioned that inventories cannot always be reduced if the 98-percent fill rate objective is to be maintained because some suppliers have not been able to meet scheduled delivery dates. We agree that inventories cannot always be reduced. Larger stocks would be needed for items with known delinquency problems, but smaller stocks would be needed for items that can be delivered in short periods of time. That is why we recommend that variances in demand and leadtime be considered in establishing stock levels for individual items.

Furthermore, we did not intend to imply that we agreed with the 98-percent fill rate objective. It probably is much too high. Other Federal agencies with major supply activities have set fill rate objectives at less than 90 percent.

SUMMARY OF SAMPLE SELECTIONBY DIVISION AND STRATA

| <u>Division</u>                             | <u>Strata</u>    |                            | <u>Number<br/>of items<br/>sampled</u> |
|---|------------------|----------------------------|--|
|   | <u>Type</u>      | <u>Number<br/>of items</u> |  |
| Medical and scientific<br>supplies (note a) | High value       | 38                         | 38                                     |
|   | Random selection | 421                        | 30                                     |
| Administrative supplies<br>and equipment    | High value       | 1                          | 1                                      |
|   | Random selection | 69                         | 30                                     |
| Subsistence                                 | High value       | 12                         | 12                                     |
|   | Random selection | 124                        | 30                                     |
| Drugs and chemicals                         | High value       | 48                         | 30                                     |
|   | Random selection | <u>615</u>                 | <u>30</u>                              |
| Total                                       |                  | <u>1,328</u>               | <u>201</u>                             |

a/ Includes some furniture items managed by the Medical Equipment Division that are depot stocked.

Office of the  
Administrator  
of Veterans Affairs

Washington, D.C. 20420

**Veterans  
Administration**

JUNE 30 1982



Mr. Gregory J. Ahart  
Director, Human Resources Division  
U.S. General Accounting Office  
Washington, DC 20548

Dear Mr. Ahart:

These are my comments on the May 19, 1982, draft report, "VA Should Use Economic Order Quantity Principles in the Wholesale Supply System." The General Accounting Office (GAO) calculated that by using economic order quantity (EOQ) principles, the Veterans Administration (VA) could save over \$5 million annually in total costs to order and carry inventory, reduce inventory by almost \$35 million, and lessen the need for warehouse space. To accomplish this, the GAO recommends that I direct the Assistant Deputy Administrator for Procurement and Supply to:

- Adopt EOQ principles in computing wholesale inventory order quantities at the Marketing Center. Modify the principles where necessary to take advantage of quantity and transportation discounts.

The VA will implement appropriately modified EOQ principles at the wholesale level, after considering such factors as available volume discounts, the effect on transportation costs, and currently available manpower and other resources. As stated in the GAO report, we will begin this application on the high dollar volume items in our inventory. The application of modified EOQ principles should result in improved buying practices and more reasonable inventory levels.

The procurement cost data on page 16 appear to be incorrect. For example, the marginal ordering cost associated with the Medical and Scientific Division is shown as \$28.21. However, 397 of the reported 459 items in this Division (see Appendix I) require a technical acceptance inspection, costing a minimum of \$15, upon receipt. This is in addition to the normal receiving cost. GAO's use of invalid procurement data such as this raises questions about the validity of the subsequent analyses.

From an established universe of 1,328 items, GAO sampled 201 and, using statistical probability, concluded that a projected \$35 million reduction in inventory investment could be achieved. This report does not provide the necessary data to permit verification of the potential savings cited, and unless we were to apply the EOQ principles to a statistically valid sample of the Marketing Center inventory, it is not possible to accurately state what benefits might be achieved. However, I believe some reductions in potential cost, inventory level, and space needs can be made.

Mr. Gregory J. Ahart

However, existing limitations must be considered when assessing the reported benefits to be derived from EOQ. During Fiscal Year (FY) 1981, 8 Hines Depot Receiving Section full-time equivalent employees (FTEE) received and processed 7,976 line items. The report indicates that using EOQ principles would result in an increase in the annual ordering frequency of an injectable antibiotic from 3 to as many as 46 times a year per depot. An increase from 31 delivery orders a year to as many as 49 deliveries per depot is indicated for another line item. Without calculating the number of increased deliveries for all warehoused items, we cannot determine the total impact the application of EOQ principles would have on personnel needs. Undoubtedly, additional FTEE would be necessary in the Hines Depot Receiving Section. More frequent ordering would also increase the need for clerical personnel at the Marketing Center, for operational personnel at all three depots to process the projected increase in receipts, and for fiscal and stock control at the Hines Depot.

The physical limitations under which the depots operate must also be considered. There are 13 dock spaces at the Hines Depot. An average of 20 trucks per day make deliveries; 5 dock spaces are normally assigned for deliveries and 8 spaces for outbound shipments. A sizeable increase in deliveries, even after discounting the smaller shipments, would establish a need for several more dock spaces for deliveries alone.

--Reduce existing excess inventories compatible with EOQ principles.

I agree that using the EOQ principles should result in an inventory reduction. However, the introductory statement on page 1 of the report infers that the VA suffers "...a severe financial loss" by having to purge excess inventory. The VA does not experience a severe financial loss. During FY 1981, Supply Depot inventories averaged \$57.5 million. The amount which required disposition because of age or other factors was \$307,473, or approximately 0.5 percent. Of that amount, \$283,819 was returned to the vendors for credit. Only \$23,654 in inventory was either marked down or destroyed. This represents a loss of approximately 0.04 percent. The current estimated amount of inventory which will either be marked down or destroyed during FY 1982 is \$37,840. This is less than 0.07 percent of the inventory which now averages \$57.6 million.

--Assess the impact of EOQ on the need to expand the storage facilities at the Hines supply depot.

The Hines Depot expansion project would not be materially affected by using EOQ. The project includes only about a 10 percent net increase in actual warehousing or storage space. The Depot averages a 90 percent space occupancy in contrast to a recognized ideal occupancy rate of 80 percent so the small increase will, even with a modified EOQ application,

Mr. Gregory J. Ahart

only allow a degree of flexibility necessary for efficient management of operations. The expansion project also includes corrections of cited fire and safety deficiencies, increased receiving areas, and additional office facilities.

I agree with the example cited--using EOQ principles will reduce the electric bed inventory and free more storage space. (This inventory is being reduced and will ultimately be phased out.) However, I do not foresee any additional significant amount of storage space becoming available as a result of applying EOQ principles. In any physical distribution system, space required is expressed as a cubic measure, so any reduction in inventory begins at the top of the stack and works down. Only when a complete stack is eliminated can an actual reduction in needed warehouse space be realized. In addition, a straightforward application of EOQ would result in an increase in the number of individual deliveries, requiring a larger dock and receiving area because of the need to segregate items.

--Establish a continuing process to assure that the costs to order and carry stocks are reasonable and current and provide the ability to determine that the lowest total overall costs are being incurred when replenishing depot stocks.

This Agency will continue its efforts to assure that costs to order and carry stocks are reasonable and current. However, the report contains several examples of overstated potential benefits to be derived by the application of EOQ principles. The range of estimates and statistical projections of reductions listed by division on page 12 is apparently incorrect. The range of reductions for the Drugs and Chemicals Division indicates a high potential reduction of \$32.2 million. It would not be possible to effect a reduction of that magnitude since, at the time of the GAO review, the total value of this inventory never exceeded \$30 million.

The report also indicates a potential inventory reduction from a monthly operating level of 295,000 units to only 42,500 units for liquid vanilla dietary supplement. Although some reduction is attainable, the suggested 42,500 unit monthly level, representing only a 2.8-day supply according to actual demand history, is not realistic.

In order to improve supply management and further reduce the inventory investment, GAO recommends that I direct the Assistant Deputy Administrator for Procurement and Supply to

--establish inventory management policies which relate safety levels to demand and leadtime variances for individual items, and

Mr. Gregory J. Ahart

--use actual leadtime data in determining procurement leadtime stock levels for individual items. In developing the data, vendors should be consulted.

VA did have inventory management policies in effect at the time GAO made their survey but GAO considered them inadequate. Since that time, the Office of Procurement and Supply has reorganized some of the functions at the Marketing Center. Inventory control was one of the functions which was improved by consolidating inventory management of various commodity groups into one division. Operating policies for that division are being developed and they will require that safety levels of stock be related to demand and leadtime variances be related to individual items.

The vendors GAO contacted concerning procurement leadtime needs indicated they could deliver their orders in much less than the 60 to 90 days currently allowed by the Marketing Center. However, a review of the FY 1982 delinquent order status revealed an 11 percent average monthly delinquency rate for total due-ins. It is apparent that more than a few of our suppliers cannot meet scheduled delivery dates. In view of this, if the VA is to achieve and maintain the ability to fill 98 percent of orders from stock on hand, the objective stated on page 19, inventories cannot be reduced as recommended.

Thank you for the opportunity to comment on this report.

Sincerely,



ROBERT P. NIMMO  
Administrator

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